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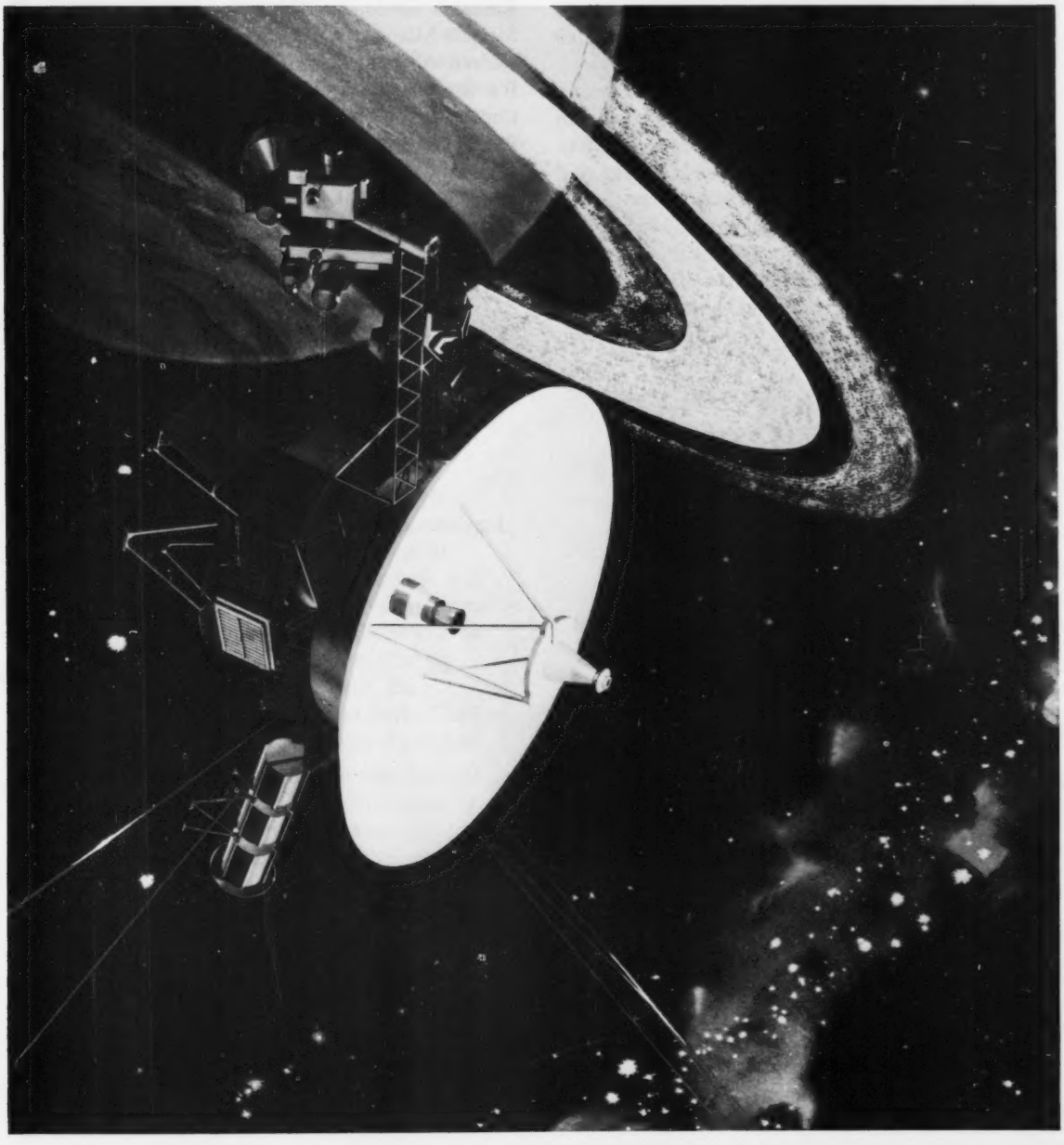

COVER

Multibillion Miles Away—As an artist sees it, Voyager 1 passes beneath the rings of Saturn after the encounter on November 12. Voyager 2, at this point, was nine months behind and speeding toward its rendezvous with Saturn in August 1981. When Voyager 1 made its flyby of the ringed planet, it had traveled more than 2 billion kilometers since launch.

The twin spacecraft, after completing their planetary missions, will search for the outer limit of the solar wind—that presumed boundary somewhere in our part of the Milky Way where the influence of the Sun gives way to that of other stars of the galaxy. If all goes as planned, Voyager will target on far Uranus in 1986.

Table of Contents

Letter from Washington	3
Voyager Takes Close Look at Saturn	4
"Rollover"	7
Shuttle Engine Nozzle Tested	7
Fourth FLTSATCOM Launched	8
Mars Photo Book Published	9
Refuse-Burning Plant Dedicated	9
MSFL Begins Gravity Probe	10
Kerrebrock to Head Aeronautics	10
JSC's New Water Tank	11
NASA Mourns Dr. Mutch	11
Research Session at AU	12
Satellite Monitors Moth Damage	13
Reflections from Earth	14
It's Supermetal!	14
Contractor News	16
Patents for Inventions	17
Did You Know?	18
Launches for 1980	18
Another Dividend from Air and Space	20

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Letter from Washington

Dear Colleagues:

This will be my last holiday season as NASA Administrator, and I again convey my thanks for all the support and selfless good will that the people of this agency have shown me. I take with me not only appreciation, but an abiding respect for a government work force that is the epitome of professionalism. Years of experience usually do provide a certain competence in this government service, but a true professional carries it farther. Besides knowing his or her job, the NASA employee is motivated far above the normal by a firm knowledge of the *importance* of this work. We are accomplishing things never done before in science and high technology, engineering, in aeronautics, medicine and in improving the very quality of life. At NASA, this is a shared conviction and it serves to set this agency apart.

The year that is closing out has been historic. That is a statement traditional in Christmas messages and in the case of NASA, in every decade of its existence, especially true. Every year, we have seen goals met and achievements realized totally without precedent. The Voyager encounter with Saturn last month is just the beginning. Next year, after the sister spacecraft has made its approach, the Voyagers will proceed on to the outer limits, 2 billion miles from Earth, and a visit to Uranus if possible.

Nineteen-eighty has seen a remarkable return of pictures and information from Solar Maximum Mission; the Space Telescope and Galileo projects are proceeding well, promising a valuable schedule of exploration in deep space through the rest of the decade. Mars and the Viking expeditions there have opened the way to further automated investigations. VOIR, and the unveiling of Venus, lies ahead.

The Space Shuttle holds the key to further missions. In three short months, in the culmination of intensive preparation and hard work, Pad 39A at the Kennedy Center will tremble to the roar of Columbia's departure. The Space Transportation System will be launched with the first orbital test flight and the way will be open to man's permanence in space. It will mark a giant step in world communications and it will place us in a new position to do orbital research. Construction and structures in space are sure to follow as we leave our planet routinely and at will. The Space Shuttle is the means to "technological revolution". H. G. Wells said once of space and its promise, "the choice is the universe or nothing." I know that NASA has accepted that challenge and is proceeding with all its knowledge and determination to meet it.

My tenure here has been an education as well as a service; I have learned what tangible benefits to mankind NASA provides today. I will follow with unstinting admiration your triumphs in the future. You are the opposition to the spectre of a closed society with limited resources on Earth. Your professionalism and belief in yourselves will carry us to better horizons. Whether there is extraterrestrial intelligence already out there or not, we are embarked on creating extraterrestrial intelligence: ourselves.

Sincerely,

Robert A. Frosch

Voyager Takes Close Look at Saturn

In what has been called the greatest mission of planetary discovery, marking the third episode in a decade-long, multibillion-mile space odyssey to the outer planets and beyond. Voyager encountered the ringed planet on Nov. 12, making its closest approach at approximately 6:45 p.m. EST at a distance of 124,200 kilometers from the visible cloud tops.

The flyby of Saturn came more than 20 months after Voyager's close approach to Jupiter in March 1979, and 16 months after a sister craft, Voyager 2, made its Jovian encountered in July 1979.

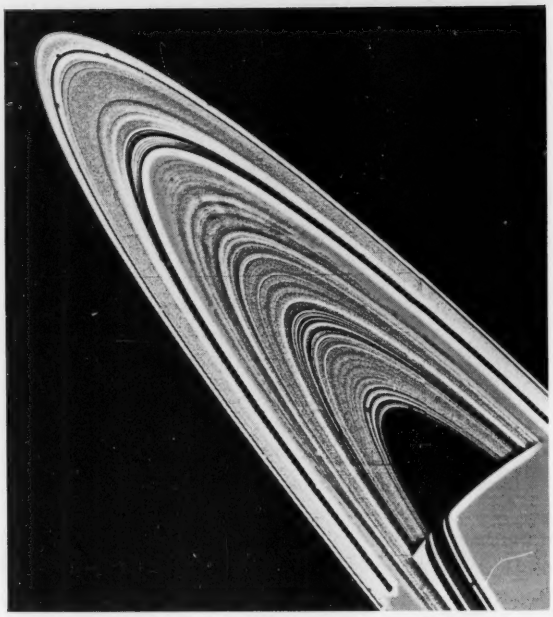
Voyager 1's detailed scientific examination of Saturn, its rings and moons, is the NASA spacecraft's final planetary encounter before it leaves the solar system about 1990. Voyager 2 will encounter Saturn later next year, followed by possible Uranus and Neptune encounters in 1986 and 1989 respectively.

The closeup looks at the outer planets are the most current steps in the United States program of systematic planetary exploration, in which the solar system is used as a natural laboratory. By being able to compare the similarities and differences of the various planets, scientists hope to learn more about the history and future of the solar system and particularly our own planet Earth. The outer planets, evolving at a different rate and under different conditions than the inner planets—Mercury, Venus and Mars—play a particularly important role in this effort.

A prime target for study by Voyager 1 was Saturn's satellite Titan, the large moon in the solar system now known to have an extremely cold, nitrogen atmosphere. The spacecraft approached Titan at a distance of 4,000 km from the surface, the closest approach to any body in the Voyager mission, on Nov. 12 at 12:41 a.m. EST (spacecraft time).

The same day, Voyager also made its closest approach to Saturn and the satellites Tethys (415,320 km) at 5.16 p.m. EST; Mimas (88,820 km) at 8:42 p.m.; Enceladus (202,521 km) at 8:50 p.m.; and Dione (161,131 km) at 10:39 p.m. Closest approach to Rhea (72,000 km) was at 1:21 a.m. EST on Nov. 13.

When the two Voyager spacecraft have completed their television experiments they will have sent more than 70,000 pictures of Jupiter, Saturn and its rings, 13 satellites and black space near the two planets. Black-space imaging at Jupiter resulted in discovery of one its three newly found moons.



Saturnian Ring Scrutiny—This computer composite of four Voyager 1 photos contains a wealth of new information on the rings of Saturn, including subtle color variations and startling "braided" rings. Voyager took the pictures in November from 8 million kilometers away and they were combined and enhanced in the Image Processing Lab at Jet Propulsion Laboratory. Portions of all of Saturn's rings can be seen: small arc-shaped feature is part of the F-ring. Next inward is the A-ring, split by the dark Enke Division. Dark region between A-ring and B-ring is Cassini Division, filled with material discovered by Voyager 1. Innermost ring visible is the C-ring, each of the planet's four main rings appears to be composed of several finer rings.

At Saturn, as at Jupiter, Voyager's radio signals were used extensively to measure the atmospheres of the planet and satellites and assess the size and density of the ring particles.

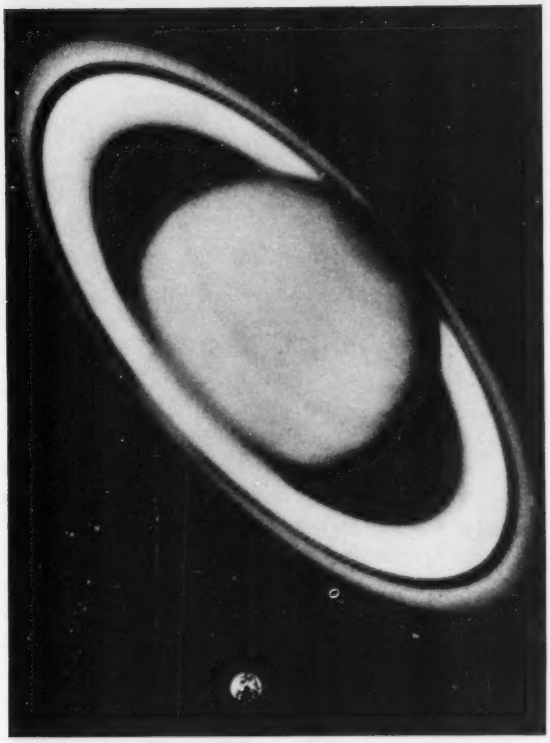
The Voyager 1 trajectory includes occultations of the Earth and Sun by Titan, Saturn and the rings, During these three occultations, Earth is eclipsed by Titan, Saturn and the rings from the spacecraft's point of view. As Voyager passes behind each body, its radio signals pass through the atmospheres of Saturn and Titan and through the rings toward Earth; resultant changes in the radio signals will provide information on characteristics of the planet's and satellite's atmospheres, ionospheres and the size and density of ring particles.

Each Voyager uses 10 instruments and the spacecraft radio system to study the planets, their principal satellites, Saturn's rings, the magnetic and radiation regions surrounding the planets, and the interplanetary medium. (The photopolarimeter on Voyager 1 had failed and was not used at Saturn; the one on Voyager 2 is still operating.)

The Voyagers are carrying telescope-equipped television cameras, cosmic ray detectors, infrared spectrometers and radiometers, low-energy charged-particle detectors, magnetometers, photopolarimeters, planetary radio astronomy receivers, plasma detectors, plasma wave instruments and ultraviolet spectrometers.

The spacecraft began the observatory phase of its encounter on Aug. 22 and will conclude the 117-day surveillance of the Saturnian system on Dec. 15.

Voyager 2 will follow its sister spacecraft to Saturn in August 1981. Its possible four-planet itinerary includes encounters with Uranus in January 1986 and Neptune in August 1989.



Planetary Comparison—The size of Saturn and the Earth are shown in this photograph synthesizing separate pictures. The diameter of the ringed planet is 126,400 kilometers, ten times that of Earth; more than 300 Earths could fit into the volume of the other. At the same time, Saturn has such little density that the whole planet could float in an ocean, if there were one large enough to hold it.

Saturn is the sixth planet from the Sun, second largest in the solar system. Like Jupiter, it is a giant sphere of gas—mostly hydrogen and helium with a small core of rocky material. The planet takes 29.46 years to complete one orbit around the Sun, which is approximately 1.42 billion km away. A day on Saturn lasts 10 hours, 39 minutes, 24 seconds.

Until recently, Saturn was believed to be the only planet encircled by rings. But both Jupiter and Uranus were discovered to have thin, barely visible rings. (The Jovian ring was discovered by Voyager.) Saturn's rings, however, are much richer in material, probably chunks of ice and dirt, and are bright and highly visible from Earth-based telescopes.

At least six rings surround Saturn. From the planet outward, they are designated D, C, B, A, F and E. Divisions between the rings are believed to be caused by the three innermost satellites, Mimas, Enceladus and Tethys. The Cassini Division, a space between the B and the A ring, is the only division clearly visible with a small telescope from Earth.

The Encke Division is a small gap in the rings. The Pioneer spacecraft, which flew past Saturn in September 1979, detected a gap between the A and F rings. Pioneer also reported a third division between the C and B rings.

Saturn's face, in comparison to Jupiter's, is bland and tranquil in appearance. This may be due to thick, high-altitude haze that gives Saturn its opaque appearance, hiding weather activity in the planet's atmosphere.

Saturn has at least 13 satellites, though many more not yet discovered may orbit the planet. The existence of 10 has been known for some time and these objects have been named; of the three recently discovered satellites, two appear to share the orbit of Dione and one of Enceladus. From the planet outward, the 10 named satellites are Janus (whose existence is now doubtful), Mimas, Enceladus, Tethys, Dione, Rhea, Titan, Hyperion, Iapetus and Phobe.

In its excursion though the Jovian system, Voyager 1 discovered a wispy ring of particles around Jupiter and towering volcanoes on Io. Superbolts of lightning and immense auroras were found in the planet's violently churning atmosphere.

More than 18,000 pictures of Jupiter, the four Galilean satellites—Io, Europa, Ganymede and Callisto—and tiny Amalthea were obtained with

Voyager 1's two-camera imaging system during the 98-day encounter. Voyager 2's visit to the Jovian system yielded an additional 15,000 pictures of the giant planet and its satellites.

Using Jupiter's enormous gravity, the two spacecraft were hurled onto trajectories toward Saturn. When Pioneer 10 and 11 passed through Jupiter's intense radiation in their 1973 and 1974 encounters, the two Voyagers were still being assembled. Based on data from the Pioneers, some Voyager parts were exchanged for more radiation-resistant components, electronic circuits were modified, and additional radiation shielding was added to each spacecraft. As a result, the Voyagers suffered little damage in their flybys of Jupiter.

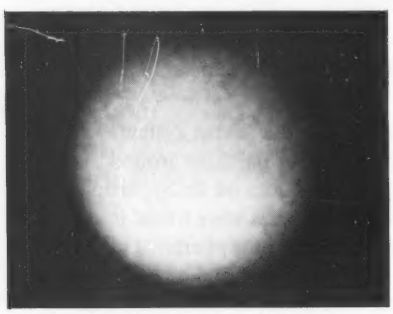
Saturn's radiation is much gentler than Jupiter's. When Pioneer 11 flew beneath Saturn's rings, radiation intensity dropped dramatically, showing that charged particles are interrupted and absorbed by particles in the rings.

Voyager 2 was launched Aug. 20, 1977, from Cape Canaveral, Fla., aboard a Titan Centaur rocket. Two weeks later, on Sept. 5, Voyager 1 was launched on a faster, shorter trajectory and sped past its twin before the end of the year. By the time Voyager 1 reaches Saturn, Voyager 2 will be nine months behind.

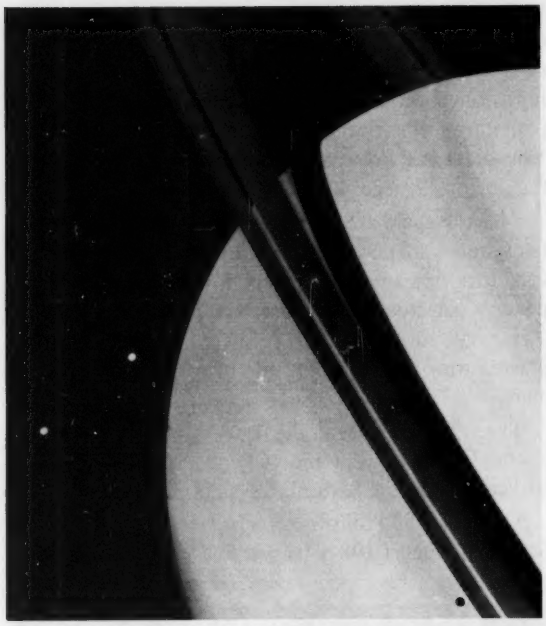
When Voyager 1 encountered Saturn it had traveled more than 2 billion km (1.24 billion mi.) since launch.

The Voyager Project is managed for NASA by the Jet Propulsion Laboratory, Pasadena, Calif., a government-owned facility, operated for the space agency by the California Institute of Technology.

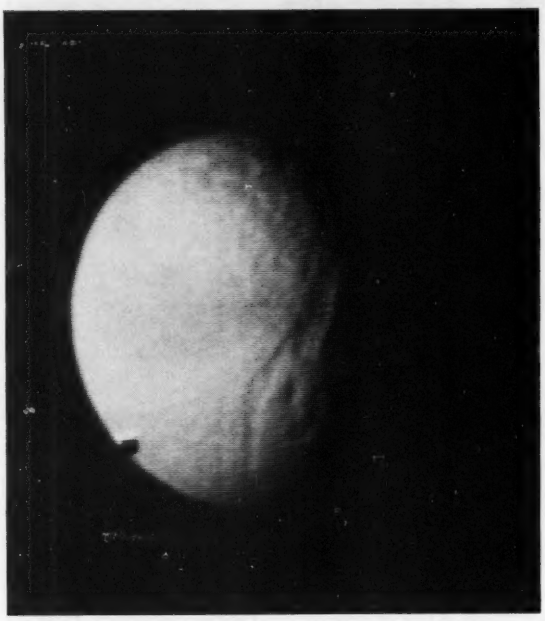
NASA program manager is Frank A. Carr, and Dr. Milton A. Mitz is NASA program scientist. Voyager project manager is Raymond L. Heacock, JPL, and Dr. Edward C. Stone of Caltech is project scientist.



Titan, the large satellite, under heavy cloud cover.



Moons Over Saturn—Two of the planet's 15 or more moons —Tethys and Dione—were photographed on November 3. The shadows of Saturn's three brightest rings and Tethys are cast onto the cloud tops.



Encounter Day—The heavily cratered surface of Tethys was photographed from a distance of 1.2 million kilometers on November 12. This face of Tethys looks toward Saturn and shows a large valley about 750 km long, a fracture of unknown origin.

Thumbs Up for March--The Space Shuttle first team gives the signal for success during a power up mission simulation in the orbiter Columbia. John Young, commander, in the left hand seat, and pilot Robert Crippen are the prime astronaut crew for the first orbital test flight in March 1981. The schedule is holding and Columbia was rolled out from the Kennedy center's Orbiter Processing Facility in November. The intensive preparation period for launch is now underway.

"Rollover"

Holding to schedule, the Space Shuttle orbiter was rolled over from its processing hanger to the Kennedy center's Vehicle Assembly Building on November 24. The "rollover" went without a hitch and now safely in the VAC, the Columbia will be wedded to its external fuel tank and two solid rocket boosters. The last of over 30 thousand thermal protection tiles will be attached in place.

If all goes well, rollout will take place the day after Christmas. The Shuttle will be moved to launch pad 39A for the remaining weeks of on-pad testing. Testing of the main Shuttle engines should be completed by January, despite a setback in early November, when three engines shut down prematurely at the NSTL test site.

Shuttle Engine Nozzle Tested

Engineers at the Marshall Space Flight Center have completed a series of vibration tests on a modified nozzle for the Space Shuttle's main engine. The tests were designed to determine if modifications to hydrogen lines on the nozzle will enable the lines to better withstand certain potentially damaging vibrations they will encounter during engine operations. While the resulting data has not yet been fully analyzed, preliminary results look good, according to Garland Johnston, Chief of the Dynamics Test Branch of Marshall's Test Laboratory.

The investigation involved the nozzle's "downcomer" and "steerhorn" lines. The downcomer is a tube which carries super-cooled liquid hydrogen fuel down the outside of the nozzle from the engine's high pressure hydrogen turbopump, and the steerhorn line, named for its shape, distributes the

hydrogen to a coolant inlet manifold which encircles the base of the nozzle. The hydrogen then flows upward through a network of smaller tubes to cool the nozzle and preheat the hydrogen fuel for combustion. There are three sets of downcomer and steerhorn lines on each nozzle.

A steerhorn line failed during a test of the Shuttle's main propulsion system in November 1979 and subsequent evaluation determined that certain vibrations generated by the engine contributed to the failure. During those evaluations it was learned that some frequencies caused the steerhorn and downcomer feedlines to move about excessively, placing high stress on weld joints.

To strengthen them against this stress, the steerhorn weld joints on the Columbia's flight engines, and the engines in the Shuttle's Main Propulsion Test Article, have been nickle plated. Permanent modifications for engine nozzles to be used on future Shuttle flights include an increase in the number of places at which the steerhorn is attached to the nozzle and the attachment of the downcomer at the top of the nozzle. Another modification which has helped reduce stress at critical points was the addition of a "steam loop" to the downcomer. This addition was made to allow for the expansion of the line due to the additional attach points, but the loop or bend in the line also acts as a soft spring to help damp out the damaging motions.

Payload Truck—Resembling an outsize covered wagon, the Space Shuttle Canister and Transporter are mated near the Kennedy center's Vehicle Assembly Building. The combination will handle and transport Shuttle payloads throughout KSC. The Canister restrains and environmentally protects the payloads in transit while the 48-wheel Transporter can move in any direction, under both diesel and electric power.

Fourth FLTSATCOM Launched

The fourth of five FLTSATCOM communications satellites was launched from the Kennedy Space Center on Oct. 30. The Department of Defense satellite went into service over the western Pacific Ocean.

FLTSATCOM-D was placed in a geostationary orbit at 172 degrees east longitude above the equator, where it will provide two-way communications in the 240 to 400 MHz frequency band, between any two points on Earth visible from its orbital location. The spacecraft has a design life of five years.

The FLTSATCOM program is managed by the Naval Electronic Systems Command. The Air Force Space Division is responsible for production, launch vehicle/spacecraft integration and tracking and data acquisition.

The FLTSATCOM satellites are the spaceborne portion of a worldwide Navy, Air Force and Department of Defense system to enable communications between naval aircraft, ships, submarines, ground stations, Strategic Air Command elements and presidential command networks. The satellite system will provide 23 ultra high frequency communication channels and one super high frequency channel.

This was the 53rd launch of an Atlas Centaur, NASA's standard launch vehicle for intermediate-weight payloads. The first Atlas Centaus was launched May 8, 1962.

NASA is reimbursed for all additive costs of the Atlas Centaur and launch services by the Department of Defense under provisions of a launch services agreement.

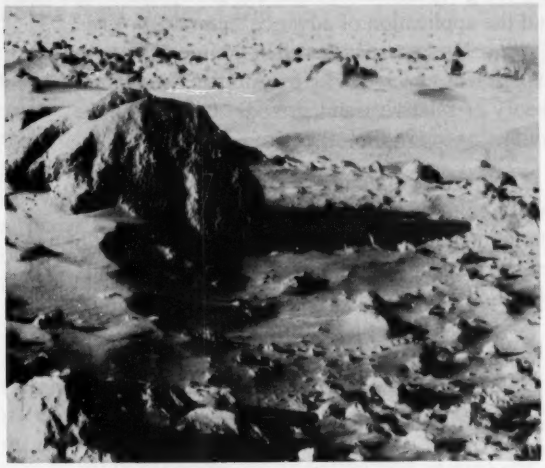
The Atlas Centaur (AC-57) launch vehicle placed FLTSATCOM-D into a highly elliptical orbit of 167 by 35,970 kilometers. After reorientation of the satellite, a solid propellant rocket motor aboard the spacecraft was fired to circularize the orbit at a synchronous altitude of 38,788 km. At that altitude, because the speed of the spacecraft in orbit matches the rotational speed of the Earth, the satellite remains in position over one spot on the equator.

NASA's Lewis Research Center, Cleveland, has management responsibility for the Atlas Centaur development and operation. NASA's Kennedy Space Center, Fla., is assigned vehicle checkout and launch responsibility once the vehicle reaches Cape Canaveral.

Mars Photo Book Published

All but one of the four Viking spacecraft sent to explore Mars are silent now, but they have left a legacy of hundreds of remarkable photographs of the Red Planet.

Some of the best of these pictures are included in a new NASA paperback publication entitled "Images of Mars: The Viking Extended Mission." Collected by Nancy Evans of the Jet Propulsion Laboratory, Pasadena, Calif., and Michael H. Carr of the U.S. Geological Survey, the pictures illustrate the varied landscape of one of the Earth's closest planetary neighbors.



The boulders of Mars are shown in the NASA photo book

The Viking spacecraft, launched in 1975, reached Mars in 1976 and transmitted back to Earth hundreds of photos of the Martian surface from orbit as well as from the surface itself. The 30 black and white photographs in "Images," some as recent as 1979, were selected not just for their visual impact, but for what they tell the viewer about the terrain they depict.

Soaring volcanoes, mysterious channels, tremendous chasms that could swallow the Grand Canyon, rocks, boulders and sand—all are shown in great clarity. The notes accompanying each photograph explain, in layman's terms, what each image shows.

This armchair guide to Mars was produced by NASA's Scientific and Technical Branch. NASA SP-444 is available for $2.25 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

LaRC Ribbon-Cutting—The new steam generating plant opens at the Langley center as a foursome makes it official. From the left, Air Force Brig. Gen. W. Troy Tolbert, NASA Administrator Dr. Robert A. Frosh, City of Hampton Mayor Thomas J. Gear, and Sen. John W. Warner, R-Va. The refuse-fired plant became operational in November.

Refuse-Burning Plant Dedicated

A refuse-fired steam generating plant in Hampton, Va. was dedicated on Oct. 9, at the site on Wythe Creek Road, next to the NASA Langley Research Center Impact Dynamics Research Facility.

U.S. Senator John W. Warner, R-Va., gave the principal address during the dedication ceremony for the $10.4 million facility which transforms refuse into energy.

Others attending included Dr. Robert A. Frosch, NASA Administrator; Billie J. McGarvey, NASA Headquarters Facility Division Director; Brig. Gen. W. Troy Tolbert, Commander, First Tactical Fighter Wing, Langley Air Force Base; Thomas J. Gear, Mayor of the City of Hampton; and other NASA, Air Force and Hampton City officials.

The plant, funded by NASA, the City of Hampton and the U.S. Air Force, will operate 24 hours a day, seven days a week. The plant's systems are now being tested and officials hope to have the facility fully operational in November.

Standard household refuse, such as paper and food waste, from the City of Hampton, the Langley Research Center, Langley Air Force Base, Fort

Monroe and the Veterans Administration will be burned at the plant.

Odors from the refuse will be dissipated inside the facility and the gases which are expelled through the smoke stacks will meet or exceed state and federal environmental protection regulations.

The plant, which is on NASA property, will be leased to and operated by the City of Hampton. The steam will be sold to NASA Langley for heating and cooling its facilities. The program originated during NASA Langley studies regarding energy conservation projects to improve the community's environment.

The plant will:

- Greatly extend the life of Hampton's sanitary landfill, and eliminate the area's federal sanitary landfill.
- Improve the environment by providing a more acceptable means of refuse disposal.
- Reduce the City of Hampton's refuse disposal cost through the sale of energy, produced by the plant, to NASA Langley.
- Save about two million gallons each year of fuel oil, now being bought by the center for its steam system.

The process of using refuse to produce steam follows a relatively simple procedure.

A truck loaded with refuse drives on the plant's tipping floor and drops its load into a refuse pit, which has a capacity of 600 to 800 tons.

A crane then picks up the refuse and drops it through a chute; at the bottom of the chute the refuse is pushed into a furnace.

The heart of the refuse-burning plant is two water-walled boilers that reduce solid waste to ash through incineration in the furnace.

As the refuse is burned, the ash falls out of the boilers on to conveyors. It is then transported to the city landfill. The volume of the ash will amount to only about one-seventh of the solid refuse brought to the plant.

The water that flows through the walls of the boiler is converted into steam to heat or cool the facilities at Langley. About 300 million pounds of steam will be produced each year. The gases in the boiler exist through an electrostatic precipitator, which cleans the gases before they are expelled into the atmosphere.

MSFL Begins Gravity Probe

Dr. Alice K. Neighbors

Dr. W. R. Lucas, director of the Marshall Space Flight Center, has established a Gravity Probe B(GP-B) Task Team within the Program Development Directorate. Dr. Alice (Joyce) K. Neighbors was named manager and Joseph C. Cody was designated chief engineer.

The GP-B is a proposed space science mission requiring sophisticated flight experiment hardware and the application of advance technology. The Earth orbital spacecraft will contain a gyro-relativity experiment which will be used to test the general theory of relativity and provide data to resolve conflicting gravitation theories.

The primary function of Dr. Neighbors' team will be to promote the focus and thrust for the planning, implementation and accomplishment of a comprehensive in-house preliminary design and definition effort for the GP-B.

Kerrebrock to Head Aeronautics

Dr. Jack L. Kerrebrock of the Department of Aeronautics and Astronautics at Massachusetts Institute of Technology, has been named Associate Administrator for Aeronautics and Space Technology at NASA Headquarters, effective June 1, 1981. He will be responsible for NASA's aeronautics, space and energy research and technology programs.

Kerrebrock has taught and conducted research in energy conversion and propulsion since 1956 when he received his Ph.D. degree from California Institute of Technology. He received his B.S. degree from Oregon State University in 1950 and his M.S. from Yale in 1951. He was an aeronautical research scientist at Lewis Research Center, Cleveland, of the National Advisory Committee on Aeronautics, from 1951 to 1953.

His early work was on nuclear rockets, space propulsion and power, and magnetohydrodynamic generators. More recently, he has been involved with the fluid mechanics of turbomachinery for aircraft

engines, and is the author of a text on aircraft engines and gas turbines. He was the director of the M.I.T. Gas Turbine Laboratory from 1968 to 1978 and is the first to hold the Richard Cockburn MacLaurin Professor of Aeronautics and Astronautics, established in memory of M.I.T.'s sixth and youngest president.

Kerrebrock replaces Dr. James J. Kramer who retired in October 1979. Dr. Walter B. Olstad, the Office of Aeronautics and Space Technology Deputy Associate Administrator, will continue to serve as Acting Associate Administrator for the interim period prior to June 1981.

JSC's New Water Tank

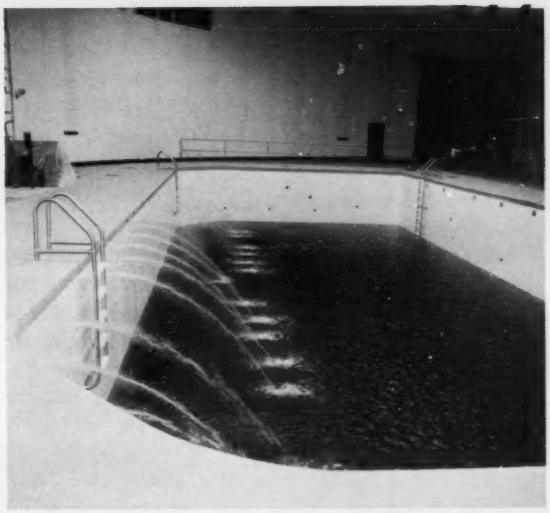
Almost everything about space—hard vacuum, temperature extremes, harsh sunlight—can be simulated on Earth, except the slow-motion weightlessness of space travel. Brief half-minute periods of zero-gravity, or weightlessness, can be duplicated by flying a roller-coaster path in an airplane, but neutral-buoyancy in a water tank is the only way to approximate long periods of weightlessness.

The Johnson Space Center in Houston began using its new water immersion facility (WIF) in October for Space Shuttle crew training. Located in the round building formerly housing the Apollo manned centrifuge, the half-million gallon tank is expected to be valuable in training Shuttle flight crews for spacewalks.

Measuring 33 feet wide, 78 feet long and 25 feet deep, the new WIF holds as much as 25 average backyard swimming pools. It replaces a circular tank 25 feet in diameter and 16 feet deep built in the mid-sixties for Gemini and Apollo emergency water egress training.

JSC and Marshall Space Flight Center will provide WIF training rockups. Marshall will furnish some payload trainers while JSC builds others including a full-size Shuttle Orbiter payload bay.

The WIF filtering and chemical systems reduce bacteria and provide clear water needed in underwater photography. Six submersible TV cameras following training operations—two operated by divers and four mounted under water with pan, tilt, and zoom, manipulated from a console at the pool's edge.



JSC's half-million gallon water tank provides weightlessness training

NASA Mourns Dr. Mutch

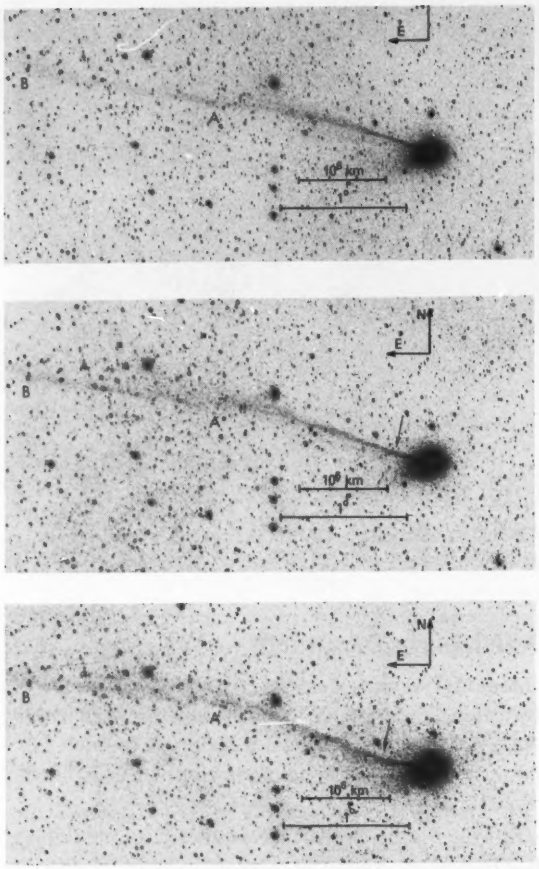
Memorial services were held at NASA headquarters in Washington for Dr. Thomas A. Mutch, 49, NASA Associate Administrator for Space Science, who was killed during a mountain climbing expedition in the Himalayas.

Dr. Mutch is believed to have suffered a fatal fall while leading an American team scaling the 23,000-foot Mount Nun-Run in Kashmir, India, about 350 miles north of New Delhi. Indian officials said the accident took place near the top of the mountain on October 7.

Dr. Mutch became NASA's Associate Administrator for Space Science in 1979, responsible for the planning and direction of the agency's over-all space science program.

He had made major contributions to NASA space science programs since 1969. He was a member of the Lunar Science Review Board from 1969 to 1973, leader of the Viking Lander Imaging Science Team from 1969 to 1977, and he chaired several NASA committees planning the post-Viking exploration of Mars.

Dr. Mutch was awarded NASA's medal for exceptional scientific achievement in 1977. He received the agency's Group Achievement Award three times for his work on the Lunar Science Team, the Viking Science Steering Group, and the Viking Undergraduate Intern Program.



Comet Wags Tail—Investigators for Goddard Space Flight Center obtained the three pictures of Comet Bradfield, while its tail underwent a violent and rapid bending as it passed the Earth last winter. Top picture: the comet just before the tail wagging. Middle: 15.5 minutes in the bend. Bottom: 27.5 minutes later, the bend reaches its fullest displacement. Investigators Dr. John Brandt and Dr. Malcolm Niedner made the observations from the observatory at Socorro, New Mexico, operated for Goddard by the New Mexico Institute of Mining and Technology.

Research Session at AU

A two-day conference begins near Washington on Dec. 10 on "keeping research and development on track", sponsored by the American University's Center for Technology and Administration. NASA participants will include Dr. Enrico P. Mercanti, Goddard Space Flight Center; Donald S. Friedman, Technology Utilization Officer, and H. J. Peake, retired Chief, Office of National Needs, both of Goddard; and David Braustein, Deputy Associate Administrator for Space Transportation Systems.

Special Guest at MSFC—Novelist James A. Michener (left) sits down with Director William R. Lucas of the Marshall center during a recent visit and is briefed on the Shuttle, Spacelab, Space Telescope and materials processing in orbit. A foremost proponent of the space agency and a very vocal advocate of space exploration, Michener is a member of the NASA Advisory Council. Recently, the author narrated and appeared in a film on the Space Shuttle, produced by Filmline Associates for the NASA Motion Picture Office.

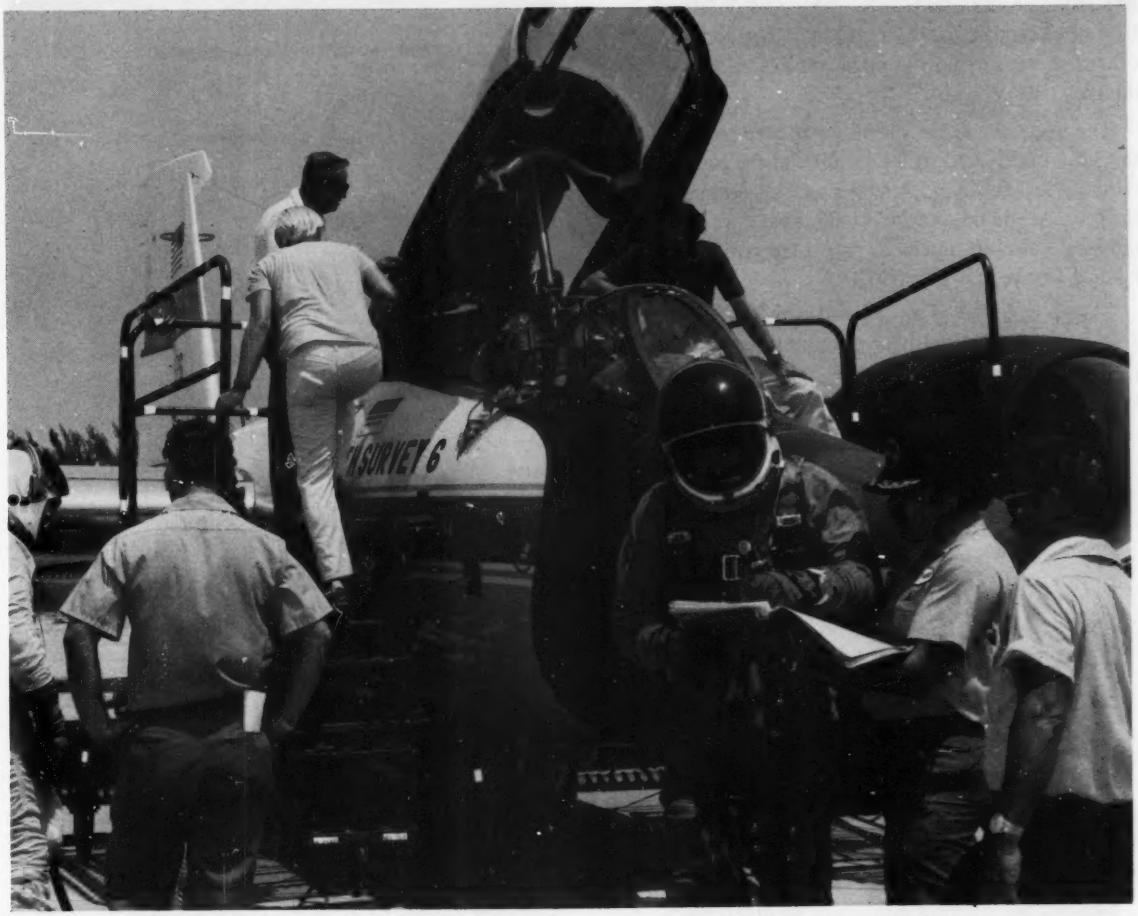
Disabled and Honored—George C. Grady (second from right) and his wife Gwendolyn hold his awards as NASA's Outstanding Handicapped Federal Employee of the Year after a ceremony at the Langley center. Richard H. Petersen, Langley Deputy Director (right), and Earl F. Stahl, Chief of the Operations Support Division, made the presentation. Grady was severely injured in 1973 while working in a pressure facility, lost most of the use of his arms and legs, and was declared 95 percent disabled. He insisted on returning to work at Langley, where his experience in high pressure systems overrides his handicap and makes him a valuable technican and instructor.

Satellite Monitors Moth Damage

A three-year pilot program to develop and demonstrate the capability of using Landsat satellite data to detect and monitor gypsy moth damage in East Coast forests has been launched by NASA and the Pennsylvania Department of Environmental Resources.

The gypsy moth caterpillar, which primarily inhabits the northeastern United States, feeds predominantly on the leaves of hardwood trees, such as oak and maple. In 1980 alone, the caterpillars defoliated 178,062 hectares (440,000 acres) of hardwood forests in Pennsylvania. Over the past 10 years, gypsy moth damage to the hardwood forests of the state has been estimated at $32,000,000.

The pilot program employs multispectral scanner data from NASA's Landsat satellites to examine hardwood forests conditions before and after defoliation occurs. This procedure allows forested areas exhibiting gypsy moth damage to be identified and located on the satellite image so that analysis of subsequent imagery can be concentrated on monitoring those areas affected.



Florida Weather Flight—Because the Sunshine State still has its share of violent weather, NASA researchers are testing new detection instruments there by plane. Flight technicians at Patrick AFB are preparing the Johnson center's WB-57F as NASA pilot Al Crews signs the flight checksheet. The aircraft carries a weather-sensing packaging developed by scientists at the Goddard center; at an altitude of 60,000 feet, the instruments will peer down and monitor thunderstorms, hurricanes and other disturbances. When the development instruments are verified, on flights controlled by KSC's Aircraft Operations Section, they are then slated for use as the "eyes" of advanced weather satellites.

Reflections from Earth

NASA's Landsat-2 satellite has captured man's first deliberate attempt to create an image on earth large enough to be recorded from outer space.

The image, a series of mirrors placed in a remote area of California's Mojave Desert, resembling a human eye, was photographed by the satellite in an experiment designed to determine the possibilities of using mirror images on the ground for improved mapmaking.

In addition, the experiment served as a forerunner of what will be a unique phase of Los Angeles' Bicentennial celebration next spring. At that time, reflections from mirrors to be placed by children from thousands of schools and by participants from other organizations will appear on a NASA Landsat image.

The mirrors will be carefully adjusted to reflect the sun into the lens of the satellite at the precise moment its Multiband Scanner records an image of the city. At the time of the satellite pass, a reconnaissance aircraft, made visible to the ground by trailing smoke, will film the event.

The project, called "Reflections from Earth," is a space age educational and festival program. The idea was conceived by Tom Van Sant, Southern California artist and sculptor, who worked closely with NASA and the U.S. Geological Survey to devise this phenomenon. Project Scientist for Landsat, Dr. Stanley Freden, of NASA's Goddard Space Flight Center, is assisting in the project by providing orbital flight information.

It's Supermetal!

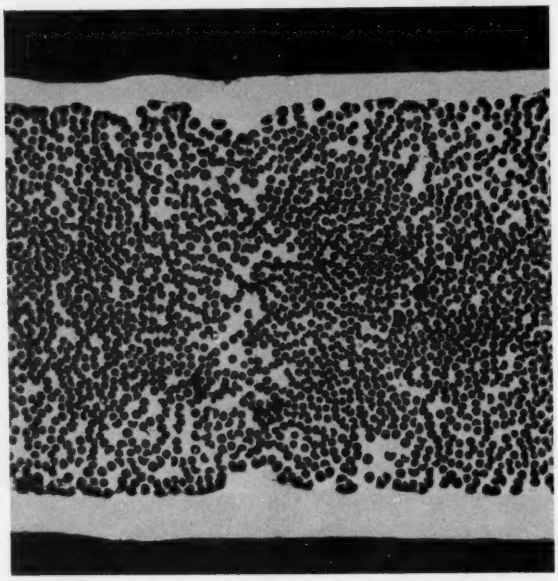
QUESTION: What metal is lighter, stronger and stiffer than aluminum and carries a lifetime guarantee in space?

ANSWER: Supermetal! Aluminum or magnesium laced with thousands of hair-thin strands of graphite fibers. Technically named, "metal-matrix composites," and now a project at the Johnson Center.

Sandwiched between aluminum or magnesium, the feather-light graphite makes the finished materials stronger, about four times more rigid and up to 35 percent lighter. Unlike other metals in space, the composite also provides thermal stability—remaining unaffected by heat or cold since graphite-metal matrix composites will not expand or contract significantly.

Because they resist solar radiation and do not "out gas," they are almost indestructible and should function in space indefinitely, says Glenn M. Ecord, senior metals engineer in the JSC Structures and Mechanics Division.

The new supermetals are being developed for space operations of the future. They will be used for large, permanent space structures, antennas, geodetic beams, solar arrays, booms and masts, large mirrors and their supports, and deployable space antennas, according to Ecord.

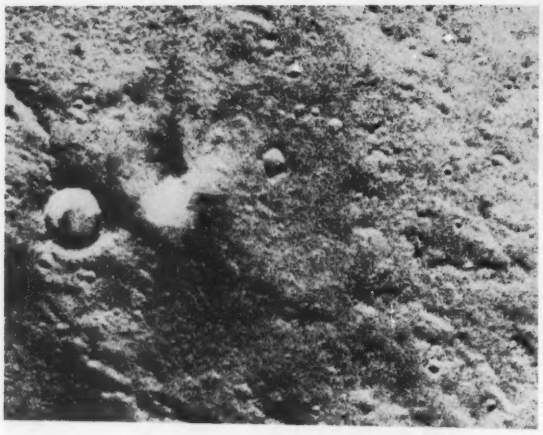


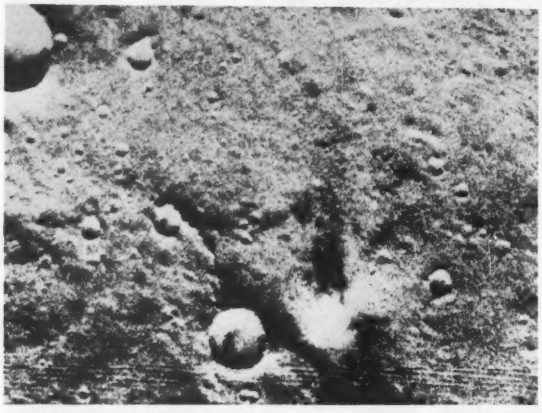
The Super Edge—Magnified 160 times, this end view of a metal matric composite, actually about the thickness of a credit card, shows thousands of dark graphite strands embedded in magnesium. They form a metal light enough and stiff enough for possible use in future space structures.

Supermetal composites also promise to benefit construction, the automobile industry and commercial aircraft with lighter and stronger structures. Although the metal-matrix composite is about 15 years old, aerospace metal specialists about four years ago learned how to produce a high quality material using a special coating to bond the graphite fibers to metal.

First such test hardware is scheduled for delivery by Lockheed to the Johnson Space Center by 1981. Lockheed will provide two wave guides—box-like devices designed to direct microwaves for solar power satellites of the future.

Cloudy Globe by Goes—This is the first cloud cover image taken by the Goes 4 satellite, launched September 9 as the first orbital mission in a joint operational and research project of NASA and the National Oceanic and Atmospheric Administration. The picture shows South America on the right with the United States seen above the center. Over southern Mexico and Honduras is a cyclonic cloud pattern associated with the remnants of Hurricane Hermine. Just south of Baja is another swirl which is a tropical depression that was a storm 12 hours earlier. To the left of this depression is another cyclonic swirl which is Hurricane Kay approaching Hawaii. The cloud pattern extending from the Middle Atlantic states southwest to Texas is the incident stage of a small storm which brought some badly needed rain after the hot, dry summer.





Martian Activity—An unusual cloud formation on the planet Mars was photographed by Viking Orbiter 1 from 500 kilometers altitude on August 1, 1978, and recently interpreted by Dr. Leonard Martin of the Lowell Observatory in Arizona. A small cloud, about 500 meters across, casts a shadow on the surface in the upper picture. In the lower picture, taken just 4½ seconds later, the cloud and its shadow have changed, and Martin says that it might be a column of steam coming from a volcano or a small volcanic event. This is the first suggestion of volcanic activity on Mars.

Contractor News

International Business Machine Corporation, with offices at 7900 N. Astronaut Blvd., Cape Canaveral, has won a modification to an existing contract to provide management and integration support for Space Shuttle payload facilities at the Kennedy Space Center. The modification has a value of almost $13 million. Under the contract, IBM will perform design, development, integration and other services for cargo integration test equipment at KSC; the services involve receiving and assembling cargo integration gear for Space Shuttle payloads.

Teledyne Brown Engineering, of Huntsville, Ala., has been selected for negotiation of a contract dealing with operation and maintenance of propellants and pressurants generating, storage and distribution facilities at the Marshall Space Flight Center. The cost-plus-award-fee contract will be for one year with two one-year options for renewal and the value is estimated to be $4.7 million.

Dynamic Engineering, Inc., of Newsport News, Va., has been awarded a NASA contract for the design and fabrication of dynamic models for use in research and development programs, with the three-year contract managed by Langley Research Center. The cost-plus-fixed-fee agreement, valued at approximately $4.3 million, includes the design, fabrication, calibration and assembly of dynamic scaled aerospace related models, systems and associated support equipment. The models are used primarily for wind tunnel testing.

Martin Marietta Corp., Denver Division, and Aerojet Liquid Rocket Co., Sacramento, Calif., have received supplemental contracts for further program and design definition of a liquid propellant boost module to provide performance augmentation for the Space Shuttle. Value of the Martin Marietta and Aerojet contracts are $1.18 million and $782,500 respectively and they call for the companies to further investigate adaptation of Air Force Titan launch vehicle hardware and production systems to the module.

The American Institute of Aeronautics and Astronautics has signed a one-year contract modification for provision of specialized information products in support of NASA's Scientific and Technical Information program. Estimated cost is over $2 million. The work will be performed at the contractor's Technical Information Service Facility in New York.

Huntsville Division of Thiokol Corporation of Utah has been awarded a letter contract for materials for fifty-four solid propellant rocket motors (Castor IVs) plus related spares, due for delivery by October 1, 1982. The value of the contract approximates $4 million. Castor IVs are used as strap-on motors to augment the Delta Space Research Vehicle. Technical direction of the Delta program is performed by Goddard Space Flight Center under the overall direction of the Office of Space Transportation Operations.

Patents for Inventions from NASA Research

The office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
Charles G. Miller, Caltech/JPL, Pasadena.	Underground mineral extraction	4,226,475	NRO/JPL
Louis B. Holdeman, Jaan Toots, Chu-Cheng Chang, National Academy of Science, Washington, D.C.	Microwave integrated circuit for Josephson voltage standards	4,227,096	MSFC
William F. MacGlashan, Caltech/JPL Pasadena.	Power control for hot gas engines	4,228,656	NRO/JPL
Graham C. Shaw, Thiokol Corp., Brigham, Ut.	Recovery of aluminum and binder from composite propellants	4,229,182	NRO/JPL
John A. Wollam, NASA/Lewis	Atomic hydrogen storage method and apparatus	4,229,195	LeRC
Wolf Elber, NASA/Langley	Partial interlaminar separation system for composites	4,229,473	LaRC
James C. Perry, NASA/Goddard	System for displaying at remote station data generated at central station and for powering remote station from central station	4,228,422	GSFC
Patricia A. Brown, San Jose University, San Jose, Calif.	Indomethacin-antihistamine combination for gastric ulceration control	4,230,717	ARC

Airborne Propellor Mount—Flying out of the Dryden center, a specially modified NASA JetStar displays a new pylon atop the fuselage designed to flight test advanced propeller models. The eight and ten bladed props will be smaller versions of the actual new hardware and will be used to study noise levels and fuel consumption. Tests conducted by Lewis Research Center indicate that the propellers could offer up to 40 percent fuel savings over current turbofan engines.

Did You Know?

Makers of the Norden Bombsight, a famous instrument in World War II that was even classed as a "secret weapon", are today heavily involved in aerospace. When the Space Shuttle achieves orbit, the astronauts will be depending on video equipment made by Norden Systems for vital information. Since 1974, Norden, under an IBM award, has designed and produced Orbiter Display Units to give Shuttle crews clear displays of vehicle guidance, control and monitoring data. The Norden firm, founded in 1928, has been widely known for the advanced military electronics systems it provides the U.S. Armed Forces.

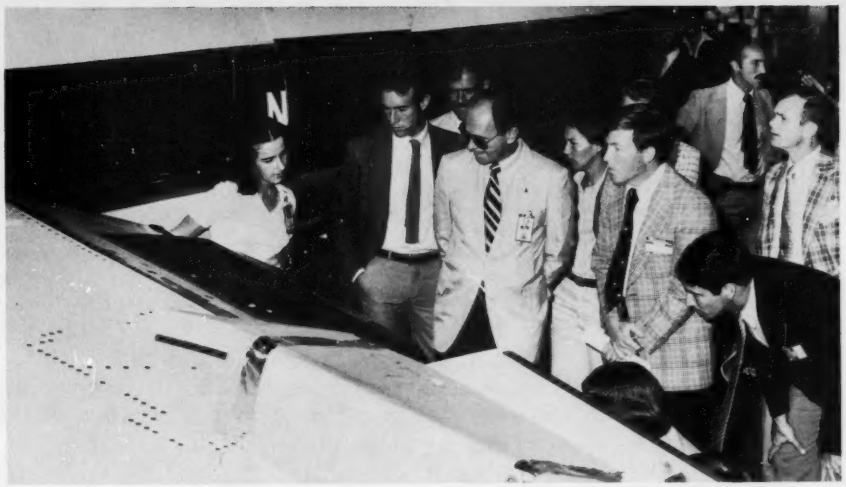
Portable Earth Terminal (PET), a traveling television studio on wheels, has ended its service at the Lewis center and begins a new career with the Federal Communications Commission in Laurel, Maryland. For three years, PET traveled across the U.S. in support of the Communications Technology Satellite, sending and receiving signals from various locations. In 1976, it relayed messages from flood victims in Johnstown, Pennsylvania, to their relatives throughout the nation. When the satellite ended its mission and was terminated, Lewis loaned the 35-foot, instrument-packed bus to FCC.

The last Univac 1108 Series computer, a workhorse at the Jet Propulsion Laboratory, has been shut down. Since the first model was installed at JPL in August 1968, the Univacs have provided reliable support, 24 hours a day, for several historic flight projects, notably Viking to Mars and the continuing Voyager mission. The General Purpose Computing Facilities at Pasadena operated as many as three multimillion dollar Univac 1108s at a time but now, said production control chief Robert Coatney, "they have fallen prey to time and the modern state of computer science" and have been replaced by more advanced systems.

Idea Clearinghouse this month cites Goddard Space Flight Center's Facilities Engineering Division for its Work Request Tracking System (WRTS). This is an automated system for tracking the progress of over 800 annual minor design and construction projects, from receipt through payment of final invoice. The WRTS replaced a manual tracking system which was used to identify the progress of individual requests. Under the old way reports to customers and managers took too much time and were not done on a regular basis. Benefits are: improved visibility for the customers and for management, a reduction in the time required to complete a requested project, and the ability to establish appropriate priorities. Monthly status reports of design and construction progress are provided automatically to users, facility managers, and safety representatives.

Launches for 1980

Name	Launch Date	Vehicle	Range	Mission Remarks
FLTSATCOM-C	January 17	Atlas Centaur	ESMC	DOD Navy. Reimbursable.
SMM-A	February 14	Delta	ESMC	NASA. Scientific Solar Maximum Mission.
NOAA-B	May 29	Atlas-F	WSMC	NOAA Weather. Reimbursable. Launch vehicle failed.
GOES-D	September 9	Delta	ESMC	NOAA Weather. Reimbursable.
FLTSATCOM-D	October 30	Atlas Centaur	ESMC	DOD Navy. Reimbursable.
SBS-A	November 15	Delta	ESMC	Satellite business systems. Reimbursable.
Intelsat V-A	December 4	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.



The New Breed—For many of the 1980 astronaut candidates, it will be a while before they fly in space. But their demanding training period has begun. In the top picture, the candidates are briefed by Dryden center employee Marta Bohn-Meyers on the Shuttle tile tests, now being conducted in California on F-104 and F-15 aircraft. In the center picture, several of the future astronauts and two European payload specialist candidates are coached in the water survival school at Homestead Air Force Base in Florida. At day's end, bottom picture, candidate for mission specialist Bonnie Dunbar has folded up her individual life raft and leaves the water with a TV camera crew trailing.

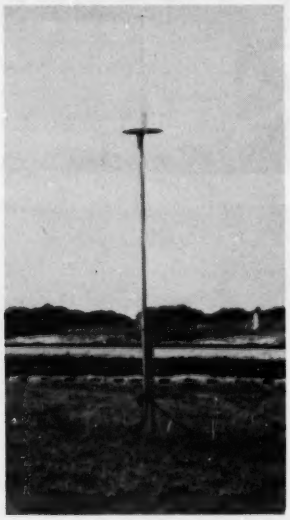
Another Dividend from Air and Space

Research and development in aeronautic and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Lightning Detector

The ground antenna pictured is part of the NASA-developed system for pinpointing the location and altitude of lightning activity. The system was devised by the Kennedy Space Center and its original purpose was to give launch controllers additional information on which to base launch or no launch decisions. Called LDAR, for Lightning Detection and Ranging, the receiver system came into being after an incident on an early Apollo Moon mission. A lightning strike, just after launch, knocked out the spacecraft's main electrical and power plant, causing a momentary loss of spacecraft instrumentation, and necessitating a readjustment. As a result, KSC initiated an active program of lightning detection and systems measuring which led to LDAR. It was used developmentally on both the Skylab and Apollo-Soyuz manned missions.

The receivers, with computer processing and display equipment, are sited at points several miles away from a central station. Each receiver picks up signals emitted by electrical discharges in parts of the sky where thunderstorms are building up. The system measures the arrival times of the signals at each station and the computer can then determine the points at which signals originate. Zones of electrical activity are shown as "blips" on a display terminal, which indicates their distance, altitude and bearing. LDAR can indicate the areas of maximum turbulence in a storm. With such precise information, air traffic controllers could route aircraft away from trouble areas.



For the benefit of all . . .

NASA
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